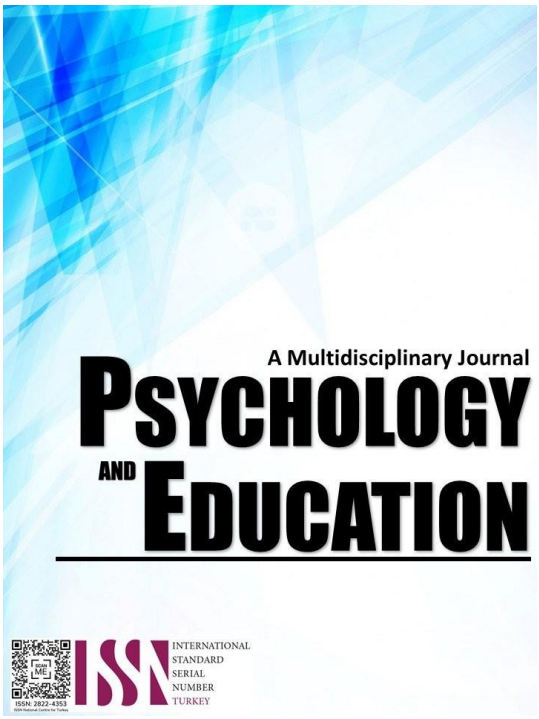
EFFECT OF TECHNOLOGY INTEGRATION TO THE NUMERACY AND LITERACY ACHIEVEMENT OF MULTIGRADE LEARNERS



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Research Article

Effect of Technology Integration to the Numeracy and Literacy Achievement of Multigrade Learners

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Abstract

This quasi-experimental study investigated the efficacy of technology integration to multigrade learners. Poor numeracy and literacy have been a problem for multigrade learners. Having multiple grade levels present in the classroom, managing a multigrade setting can be challenging. For this purpose, 22 Grade 1 to Grade 3 multigrade students of New Malinao Elementary School were selected as the subjects of the study. This paper found out that there is a significant difference between the pretest and posttest scores in numeracy of the control group multigrade learners with p = .001 which is lesser than .05 level of significance and implies that there is improvement of the numeracy of the control group after employing the traditional method of teaching. Furthermore, there is a significant difference between the pretest and posttest scores in literacy of the experimental group of multigrade learners with p = .003 which is lesser than .05 level of significance and implies that there is improvement in the literacy of the experimental group of multigrade learners after the intervention of technology. This study recommended teachers should receive ICT usage training and the assistance they require to work well in a multigrade setting. Teachers must possess the necessary knowledge and abilities to use technology to change the way they teach and generate new learning possibilities if they are to be digitally connected and guarantee ICT integration in the teaching and learning process.

Keywords: *technology, multigrade, digital, ICT, academic performance*

Introduction

Equipping the skills in numeracy and literacy have been a problem to multigrade teachers. Having multiple grade levels present in the classroom, managing a multigrade setting can be challenging. It is a challenge for a teacher to possess the necessary management skills to minimize the amount of "dead time" in which the students are not actively engaged in their work while waiting for the task given to another set of learners. This calls for teachers to be knowledgeable about various grouping techniques, the value of independent study spaces where students can go after finishing their work, and flexible assessment to cater each level's learning needs. One of the strategies is integration of technology in the teaching and learning process. According to Vongkulluksn, Xie and Bowman (2018), technology improves students' learning processes and creates a more effective, efficient, and/or appealing educational environment for the students.

Globally, a study in the Eastern United States conducted by Rogowsky et al. (2018), looked at the effects of computer-assisted instruction on the literacy and numeracy abilities of preschoolers enrolled in private, suburban childcare centers. The instruction was disguised as a playful activity and delivered via an e-tablet. Every participant took part in independently chosen creative learning centers. The computer-assisted group also finished 10 minutes of daily, individualized instruction using educational software that was interactive. Achievement test results were gathered both before and after the intervention for the study. Literacy skills (such as letter-word identification, picture/definitional vocabulary, phonological awareness), as well as numeracy skills (such as number recognition, counting, sizes/comparisons, applied problems, quantitative concepts, shapes), were compared between the groups. The study revealed better performance on the part of the students.

In the Philippines, integrating technology in the classroom is just a few of the classroom strategies used by multigrade teachers in Zamboanga City (Naparan & Alinsug, 2021). Additionally, teachers themselves challenged because of unpreparedness for teaching multiple grades, low multigrade allowances, stress, a language barrier, difficulties managing classrooms, a lack of resources, station safety, workload, absenteeism, a lack of support from stakeholders, and a lack of trainings were among the challenges. However, they showed positivity in their work and applied the right coping strategies to lessen their burden (Naparan & Castañeda, 2021).

Furthermore, in New Malinao Elementary School, where the researcher is currently teaching observed that technology resources, numeracy, and literacy performance are so challenging on the part of the teachers. Since the school is a newly established multigrade school, there are no enough facilities including electricity and computers. Hence, the teachers provided their own laptops to integrate technology in teaching. Seeing all these challenges the researcher is motivated to embark on the study to determine whether there are effects of the use of technology to the literacy and numeracy performance of the multigrade students.

Research Questions

This experimental study aimed to investigate the impact of technology integration to the numeracy and literacy achievement of multigrade learners. Specifically, this study sought to answer the following specific questions:

1. What is the pretest score in numeracy of the control and experimental group?
2. What is the pretest score in literacy of the control and experimental group?
3. What is the posttest score in numeracy of the control and experimental group?

4. What is the posttest score in literacy of the control and experimental group?
5. Is there a significant difference between pretest and posttest scores in numeracy of the control and experimental group?
6. Is there a significant difference between pretest and posttest scores in literacy of the control and experimental group?
7. Is there a significant difference between posttest scores in the numeracy of the control and experimental group?
8. Is there a significant difference between posttest scores in the literacy of the control and experimental group?

Methodology

Research Design

This study used the quantitative quasi-experimental two group pretest posttest research design. Quantitative quasi-experimental design is a type of experimental design that resembles experimentation but is not truly experimental. Participants are not randomized to conditions or sequences of conditions at random, despite the manipulation of the independent variable (Cook & Campbell, 1979). Quasi-experimental research removes the directionality issue by manipulating the independent variable prior to measuring the dependent variable. However, quasi-experimental research does not completely solve the issue of confounding variables because the participants are not assigned at random, which increases the likelihood that there are further variations between conditions (Maciejewski, 2020). Therefore, this design was appropriate to use in this study.

Participants

The subjects of the study were the 22 Grade 1 to Grade 3 multigrade students of New Malinao Elementary School – Depot ES Extension, Purok 6, Upper Ulip, Monkayo, Davao de Oro, a heterogeneous sample with ages range from 6 to 9 years old, enrolled in the school year 2022-2023. The class was divided into experimental group and control group with both having 11 students in the group. Distribution of group was done by drawing or simple lottery to assign the students for each group.

Instruments

The researcher-made pretest and posttest composed of 30 questions was the questionnaire used to gather data on the numeracy and literacy skills of the multigrade students. All items were taken from the topics of proportion from the learning materials and textbook for Mathematics 1 to 3 and proposition from the learning materials and textbook for English 1 to 3 published by the Department of Education for the implementation of the K to 12 Curriculum.

Validation of the Instrument

The test question that served as the instrument to gather vital information about the numeracy and literacy skills of the students was pilot tested to 20 Grade 1 pupils of Depot Elementary School, Purok 6, Upper Ulip, Monkayo, Davao de Oro Province and reliability-tested and validated by three experts. The test question has reliability test result of Cronbach alpha value of $\alpha = .89$ which is interpreted as good reliability. After the validation and pilot testing of the test question, the researcher had modified items that were suggested to be modified. Careful analysis of the test question was made to see that everything that is suggested will be taken into consideration.

Procedure

The following steps were followed in the gathering of data:

Seeking Permission to Conduct the Study. The researcher wrote a letter of permission to conduct the study to the Schools Division Superintendent, Division of Davao de Oro. Together with this permission letter was the endorsement letter issued by the Dean of the Graduate School of the Assumption College of Nabunturan. Certification of the ethics committee was also secured to establish the ethical standards of this study. Further, a written letter of request was also given to the principal of New Malinao Elementary School for formal consent.

Administering the Pretest and Posttest. To start the study, the pre-test was administered to the multigrade students. After four weeks in teaching using the technology integration, a post-test was administered. The results between the pre-test and post-test were treated as pupils' mean gain scores. The mean gain scores were the bases in testing the significant difference between the performance of the students in pre-test and post-test.

Data Gathering. The researcher gathered all data in the pretest after which the intervention using the technology was implemented for about four weeks and a posttest was administered. All the data gathered were subjected to statistical analyses. During the intervention the researcher used her personal computer and observed the interaction of the students during the process. AS observed, the students were very interested to participate during activities.

Data Analysis

The data obtained were tallied and tabulated. The statistical tools used to ensure the accuracy in the analyses and interpretations of the results were the following:

Percentage. This was used to determine the percentage distribution of the subjects.

Mean. Mean was used to measure the central tendency between the pretest and posttest mean scores in the numeracy and literacy skills of the multigrade students.

T-test. T-test was used in computing the significant difference of two groups of sample.

Paired t-test. The formula for a paired t-test, also known as a dependent t-test, compares the means of two related groups to determine if there is a statistically significant difference between their means.

Results and Discussion

The Pretest Scores in Numeracy of the Control and Experimental Group

The pretest scores in numeracy of the control and experimental group. Table 1 presents the pretest scores in numeracy of the control and experimental group multigrade learners.

Table 1. *Pretest Scores in Numeracy of the Multigrade Learners*

Group	*No. of Students*	*Mean*	*Class Proficiency*
Control Group	11	5.769	19%
Experimental Group	11	6.492	22%

Table 1 shows that the mean pretest score in numeracy of the control group is 5.769 with 3.468 standard deviation and the experimental group has mean pretest score in numeracy of 6.492 with standard deviation of 2.847. This further shows that the average pretest scores of the control and experimental groups are 19% and 22% from the 30 items respectively. This implies that both are poor in numeracy before the intervention.

The Pretest Scores in Literacy of the Control and Experimental Group

The pretest scores in literacy of the control and experimental group. Table 2 presents the pretest scores in literacy of the control and experimental group multigrade learners.

Table 2. *Pretest Scores in Literacy of the Multigrade Learners*

Group	*No. of Students*	*Mean*	*Class Proficiency*
Control Group	11	6.308	21%
Experimental Group	11	8.308	28%

Table 2 shows the pretest scores in literacy of the control and experimental group. Result shows that the mean pretest score in literacy of the control group is 6.308 and a standard deviation of 5.186. The experimental group has pretest mean score of 8.308 with standard deviation of 7.005. This further shows that the average pretest scores of the control and experimental groups are 21% and 28% from the 30 items respectively. This implies that both groups had little knowledge in literacy before the intervention.

The Posttest Scores in Numeracy of the Control and Experimental Group

The posttest scores in numeracy of the control and experimental group. Presented in Table 3 are the posttest scores in numeracy of the control and experimental group.

Table 3. *Posttest Scores in Numeracy of the Multigrade Learners*

Group	*No. of Students*	*Mean*	*Class Proficiency*
Control Group	11	11.077	37%
Experimental Group	11	13.692	46%

Table 3 shows the posttest scores in numeracy of the control and experimental groups. It was revealed that the mean posttest score in literacy of the control group is 11.077 and a standard deviation of 3.308 and the experimental group has a mean posttest score of 13.692 with standard deviation of 5.04. This further indicates that the average posttest score of the control and experimental groups are 42% and 60% from the 30 items respectively. This implies that both groups improved their skills in numeracy after the intervention.

The Posttest Scores in Literacy of the Control and Experimental Group

The posttest scores in literacy of the control and experimental group. Table 4 presents the posttest scores in literacy of the control and experimental groups.

Shown in Table 4 are the posttest scores in literacy of the control and experimental groups. The result indicates that the mean posttest score in literacy of the control group is 12.690 and a standard deviation of 6.250 and the experimental group has a posttest mean score

of 17.846 with standard deviation of 5.984.

Table 4. *Posttest Scores in Literacy of the Multigrade Learners*

Group	*No. of Students*	*Mean*	*Class Proficiency*
Control Group	11	12.690	42%
Experimental Group	11	17.846	60%

This further means that the average posttest scores of the control and experimental groups are 42% and 60% respectively. This implies that both groups had increased their knowledge about literacy after the intervention.

Significant Difference between Pretest and Posttest Scores in Numeracy of the Control Group and Experimental Groups

Significant difference between pretest and posttest scores in numeracy of the control group. Reflected in Table 5 is the significant difference between pretest and posttest scores in numeracy of the control group and experimental groups.

Table 5. Significant Difference of Pretest and Posttest Score in Numeracy of the Control Group and Experimental Groups

	Paired Samples T-Test				
	Measure 1	*Measure 2*	*T*	*Df*	*P*
Control	Pre-Test	- Post Test	-6.083	12	< .001
Experimental	Pre-Test	- Post Test	6.566	12	< .000

Table 5 reveals the significant difference between pretest and posttest scores in numeracy of the control group and experimental group. Paired t-test was used to determine if there is a significant difference between the pretest and posttest scores in numeracy of the control group with p = .001 which is lesser than 0.05 level of significance which means that there is a significant difference between the pretest and posttest scores in numeracy of the control group. Furthermore, paired t-test was used to determine if there is a significant difference between the pretest and posttest scores in numeracy of the experimental group with p = .000 which is lesser than 0.05 level of significance which means that there is a significant difference between the pretest and posttest scores in numeracy of the control group. This suggests that there is an improvement of the numeracy skill of both control and experimental groups that implies both traditional and technology integration are effective.

Significant Difference between Pretest and Posttest Scores in Literacy of the Control Group and Experimental Group

Significant difference between pretest and posttest scores in literacy of the control and experimental group. Table 6 presents the significant difference between pretest and posttest scores in literacy of the control and experimental groups.

Table 6. Significant Difference of Pretest and Posttest Score in Literacy of Control Group and Experimental Group

	Paired Samples T-Test				
	Measure 1	*Measure 2*	*T*	*Df*	*P*
Control	Pre-Test	- Post Test	-3.706	12	.003
Experimental	Pre-Test	- Post Test	6.566	12	.000

Table 6 shows the results of the computation using paired t-test to determine if there is a significant difference between the pretest and posttest scores in literacy of the control group with p = .003 which is lesser than 0.05 level of significance which means that there is significant difference between the pretest and posttest scores in numeracy of the control group. Additionally, using paired t-test to determine if there is a significant difference between the pretest and posttest scores in literacy of the experimental group with p = .000 which is lesser than 0.05 level of significance which means that there is significant difference between the pretest and posttest scores in numeracy of the experimental group. It is revealed that there is an improvement in the literacy skills in both control and experimental groups after the students were exposed to conventional teaching and the use of technology as the intervention.

Significant Difference between Posttest Scores in Numeracy of the Control and Experimental Group

Significant difference between the posttest scores in numeracy of the control and experimental group. As shown in the table is the significant difference between the posttest scores in numeracy of the control and experimental groups.

Table 7. *Significant Difference of Posttest Scores in Numeracy of the Control and Experimental Group*

	Independent Samples T-Test		
	t	*df*	*p*
Post Numeracy	-1.565	24	0.131

Table 7 presents the significant difference between the posttest scores in numeracy of the control and experimental group. Independent t-test was used to determine if there is a significant difference between the posttest scores in numeracy of the control and experimental groups with p = 0.131 which is more significant than 0.05 level of significance which means that there is no significant difference between the posttest scores in numeracy of the control and experimental groups. This suggests that both traditional and the use of technology are effective in teaching numeracy skills of the students. This is so since the students are already used to the traditional way of teaching.

Significant Difference between Posttest Scores in Literacy of the Control and Experimental Group

Significant difference between the posttest scores in literacy of the control and experimental group. Presented in Table 8 is the result of the computation to determine if there is a significant difference between the posttest scores in literacy of the control and experimental groups.

Table 8. *Significant Difference of Posttest Scores in Literacy of the Control and Experimental Group*

Independent Samples T-Test			
	t	*df*	*p*
Post Literacy	-2.148	24	0.042

Table 8 shows the significant difference between the posttest scores in literacy of the control and experimental groups. Independent t-test was used to determine if there is a significant difference between the posttest scores in literacy of the control and experimental group. The p value is 0.042 which is lesser than 0.05 level of significance this means that there is a significant difference between the posttest scores in literacy of the control and experimental groups. The use of technology is effective in enhyancing the literacy skill of the students which is an indication that the use technology in teaching is more than the use of traditional teaching.

Mean pretest score in numeracy of the control and experimental groups. Based on the result of the pretest score in numeracy, both groups are not performing well and they are poor in numeracy. Before the intervention, the students in the control experimental groups were not good in numeracy. This is parallel to the result of the study by Auio et al. (2021), which stated that poor early numeracy ability may also be a sign of future problems with learning mathematics. For example, poor early numeracy performance can be shown in children's weak counting, weak numerical relationship, and weak fundamental arithmetic skills during routine school activities (e.g., recite number word sequence, enumerate).

Mean pretest score in literacy of the control group and experimental groups. It was revealed that both groups are not knowledgeable in literacy before the intervention was done. This is relevant to the result of the study of Rendon and Agdana (2022) that multigrade students struggle with subject-verb agreement, reading comprehension, vocabulary, and other areas of the English language in order to create an improvement program. Additionally, students had greater trouble with reading comprehension, subject-verb agreement, and vocabulary than anything else. Multigrade students clearly had problems with vocabulary, reading comprehension, and subject-verb agreement.

The mean posttest scores in literacy of the control and experimental groups. The result indicates that there was an increase of their performance in numeracy. Both groups improved their numeracy after the intervention. This is in connection with the findings of Mortazavizadeh and Azizi Mahmoodabad (2023) that the efforts to generate relevance, connection, and ultimately integration in students' learning experiences are known as technology integration, and using this paradigm in multigrade classrooms enables teachers to improve the quality and speed of the teaching-learning process. The findings demonstrate how well technology-integrated teaching raised students' math problem scores in multigrade classrooms.

The mean posttest score in literacy of the control and experimental groups. Both the control and experimental groups increased their perfrmance in literacy. However, the experimental group had significantly improved their performance as compared with the performance of the control group even if the latter had also shown improvement of their performance in literacy. This result is parallel to the findings of Alda and Gementiza (2023) saying that since public multigrade schools are in places with limited access to educational technologies, learning resources, and materials, teaching core reading skills in a multigrade curriculum can be difficult for instructors in these schools. One further scenario to consider in a multigrade classroom is when students are divided into two or more grade levels, each of which represents a distinct learning speed.

Significant difference between the pretest and posttest scores in numeracy of the control group and experimental group. There was improvement of the numeracy of the control group after employing the traditional method of teaching. This is in context with the findings Taole (2024) in integrating technology that with the help of pedagogical affordances provided by technology, teaching and learning in multigrade classrooms can be revolutionized and enhanced.. Teachers must possess the necessary knowledge and abilities to use technology to change the way they teach and generate new learning possibilities if they are to be digitally connected and guarantee ICT integration in the teaching and learning process. The multigrade context and rural location, which create problems like a lack of basic technology infrastructure, insufficient training on integrating technology in teaching, time constraints, the teaching context, and principal support, make it challenging for teachers to integrate technology into their lessons.

Significant difference between the pretest and posttest scores in literacy of the control group and experimental group. There was improvement in the literacy of the experimental group intervention. This is contradictory to the findings of Ahmad and Akhter (2021) saying the Punjabi literacy centers' cognitive capacities were not negatively impacted by the multi-grade instruction approach. The study demonstrated that a multi-grade teaching system can save a significant amount of national capital without having an adverse effect on students' cognitive capacities when compared to the Punjab government's per-student expenditure on the education of formal students and literacy learners.

Significant difference between the posttest scores in numeracy of the control and experimental groups. It was revealed that both the traditional and the intervention using technology are equally affected the numeracy of multigrade learners. There was no significant difference between the posttest scores in numeracy of the control and experimental groups. The result relates to the study of Talor (2022) that in certain instances, this can lead to youngsters becoming more involved in technology-enabled individualized learning interventions, putting in more effort to learn, and ultimately achieving higher levels in mathematics. Because of this, effect sizes from previous research may not accurately reflect the true effects of TSPL, and there may be constraints due to the possibility that the novelty effect will wear off. Furthermore, software learning exercises can involve a lot of repetition, which gives students a greater level of program familiarity that they can use to game the system and get better grades.

Significant difference between the posttest scores in literacy of the control and experimental groups. The result speak about the significance of the use of technology in the literary skills of both control and experimental groups. It simply shows that the use of technology impacted literacy skills of the students more than the use of traditional teaching. This is related to the findings of Hwang, Lee and Shin (2023) about AI technology in improving literacy stating that with the use of artificial intelligence (AI)-generated graphics and the participants' initial and revised prompts, this study showed how learners' prompt literacy skills emerged. The survey results also demonstrated how the participants thought working on the targeted AI-powered project had improved their vocabulary acquisition techniques. Three advantages of prompt literacy development were also identified by the participants in their post-project reflection: the satisfaction of seeing desired results materialize; the realization of its significance for communication, problem-solving, and career advancement; and the improved comprehension of the cooperative character of human-AI interaction.

Conclusions

Based on the results of the study, the researcher has come up with the conclusion that there is significant difference between the pretest and posttest scores in numeracy in both control and experimental groups. This implied that both pedagogies impacted numeracy of the multigrade learners. Moreover, the results also revealed that there is a significant difference between the pretest and posttest scores in literacy in both control and experimental groups. This implied that both strategies positively impact the literacy of the multigrade learners. Furthermore, it was also found out that there is no significant difference between the posttest scores in numeracy control and experimental groups. This implied that both traditional teaching and technology integration are equally significant in the numeracy of multigrade learners. Lastly, it reveals that there is significant difference between the posttest scores in literacy of the control and experimental group of multigrade learners. This implies that the use of technology impacted literacy skills of the students more than the use of traditional teaching.

After a profound consideration on the possible implications of the findings and conclusion of the study, the researcher came up with the following recommendations:

Research on the technology integration to impact numeracy should be monitored and conduct study again with variety of technology integration for comparison. Since the difference between the two variables was found to be not significant, appropriate precautions should be taken, and variety of technology-integrated activities should be compared with its efficacy.

Teachers should receive ICT usage training and the assistance they require to work well in a multigrade setting. Teachers must possess the necessary knowledge and abilities to use technology to change the way they teach and generate new learning possibilities if they are to be digitally connected.

School administrators must create a policy that calls for quick action to close any gaps and overcome any obstacles in implementing ICT-enhanced pedagogy in multigrade classrooms. These suggestions might also be a helpful starting point for expanding the digital learning intervention and creating technology-based curricula in multigrade schools around the country

Future research on the efficacy of different technology-based pedagogies applied in multigrade schools is recommended. It is also suggested to explore additional sets of domains under technology-integration to prepare learners digitally.

References

Ahmad, G., & Akhter, M. (2021). EFFECT OF MULTI-GRADE TEACHING ON STUDENTS'COGNITIVE ABILITIES IN MULTI-GRADE LITERACY CENTERS OF PUNJAB. Pakistan Journal of Society, Education & Language, 7(2).

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. Frontiers in psychology, 13, 920317.

Alda, R., & Gementiza, J. I. (2023). Reading Instruction in Multigrade Classes: A Narrative Inquiry. Interdisciplinary Research Review, 18(3).

Almuntashiri, A., Davies, M. D., & McDonald, C. V. (2016).The Application of Teaching Quality Indicators in Saudi Higher Education by the Perspective of Academics. Journal of Education and Practice, 7(21), 128-137.

Aunio, P., Korhonen, J., Ragpot, L., Törmänen, M., & Henning, E. (2021). An early numeracy intervention for first-graders at risk for mathematical learning difficulties. Early Childhood Research Quarterly, 55, 252-262.

Back, M., Kaufman, D., & Moss, D. M. (2021). Enhancing orientation to cultural difference: the role of reentry work for teacher candidates studying abroad. Journal of Research in Childhood Education, 35(2), 297-310.

Barni, D., Danioni, F., &Benevene, P. (2019). Teachers' self-efficacy: The role of personal values and motivations for teaching. Frontiers in psychology, 10, 1645.

Brown, C. G. (2012). A systematic review of the relationship between self-efficacy and burnout in teachers.Educational and Child Psychology, 29(4), 47.

Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations. Turkish Online Journal of Educational Technology-TOJET, 11(4), 273-282.

Cansoy, R., Polatcan, M., &Parlar, H. (2018). Research on Teacher Self-Efficacy in Turkey: 2000-2017. World Journal of Education, 8(4), 133-145.

Chirico, F., Taino, G., Magnavita, N., Giorgi, I., Ferrari, G., Mongiovì, M. C., &Imbriani, M. (2019). Proposal of a method for assessing the risk of burnout in teachers: the VA. RI. BO strategy. Giornaleitaliano di medicinadellavoroedergonomia, 41(3), 221-235.

Choong, Y. O., Ng, L. P., Na, S. A., & Tan, C. E. (2019). The role of teachers' self-efficacy between trust and organisational citizenship behaviour among secondary school teachers. Personnel Review, 49(3), 864-886.

Cruz, A. A. D. (2020). Direct and Indirect Factors Affecting Teachers' Burnout in the New Normal.Recoletos Multidisciplinary Research Journal, 8(2), 75-86.

Curtis, E. A., Comiskey, C., & Dempsey, O. (2016).Importance and use of correlational research.Nurse researcher, 23(6).

Darling-Hammond, L. (2017). Teaching for social justice: Resources, relationships, and anti-racist practice. Multicultural Perspectives, 19(3), 133-138.

de Vera García, M. I. V., & Gambarte, M. I. G. (2019). Relationships between the dimensions of resilience and burnout in primary school teachers. International Electronic Journal of Elementary Education, 12(2), 189-196.

Delale-O'Connor, L. A., Alvarez, A. J., Murray, I. E., & Milner, IV, H. R. (2017). Self-efficacy beliefs, classroom management, and the cradle-to-prison pipeline. Theory Into Practice, 56(3), 178-186.

Dinc, E. (2019). Prospective Teachers' Perceptions of Barriers to Technology Integration in Education. Contemporary Educational Technology, 10(4), 381-398. https://doi.org/10.30935/cet.634187

Dogan, F. S., Çapan, S. A., & Cigerci, F. M. (2020). Dilemmas in Teaching English in Multigrade Classrooms: Classroom Teachers' Perceptions on English as a Foreign Language Course. Novitas-ROYAL (Research on Youth and Language), 14(1), 52-68.

Du Plessis, P., & Mestry, R. (2019). Teachers for rural schools–a challenge for South Africa. South African Journal of Education, 39.

du Plessis, A., & Subramanien, B. (2021). Teacher usage of ICT in a South African multigrade context. Perspectives on Multigrade Teaching: Research and practice in South Africa and Australia, 213-241.

Engin, G. (2018). The Opinions of the Multigrade Classroom Teachers on Multigrade Class Teaching Practices (Multiple Case Analysis: Netherlands-Turkey Example). International Journal of Progressive Education, 14(1), 177-200.

Fabelico, F., & Afalla, B. (2020). Perseverance and passion in the teaching profession: Teachers' grit, self-efficacy, burnout, and performance. Journal of Critical Reviews.

Fauth, B., Decristan, J., Decker, A. T., Büttner, G., Hardy, I., Klieme, E., &Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. Teaching and Teacher Education, 86, 102882.

Fenster, D. (2014).Implications of teacher tenure on teacher quality and student performance in North Carolina.

Friedman, I. A., &Kass, E. (2002). Teacher self-efficacy: A classroom-organization conceptualization. Teaching and teacher education, 18(6), 675-686.

Gökyer, N. (2018). Organizational Commitment of High School Teachers.Journal of Education and Training Studies, 6(n3a), 115-125.

Grotlüschen, A., Desjardins, R., & Liu, H. (2020). Literacy and numeracy: Global and comparative perspectives. International Review of Education, 66(2), 127-137.

Guidetti, G., Viotti, S., Bruno, A., & Converso, D. (2018). Teachers' work ability: A study of relationships between collective efficacy and self-efficacy beliefs. Psychology Research and Behavior Management, 11, 197.

Haiyan, Q., Walker, A., & Xiaowei, Y. (2017). Building and leading a learning culture among teachers: A case study of a Shanghai primary school. Educational management administration & leadership, 45(1), 101-122.

Harrell, S., & Bynum, Y. (2018). Factors affecting technology integration in the classroom. Alabama Journal of Educational Leadership, 5, 12-18.

Hechter, R. P., & Vermette, L. A. (2015). Technology integration in K-12 science classrooms: An analysis of barriers and implications.

Hester, O. R., Bridges, S. A., & Rollins, L. H. (2020). 'Overworked and underappreciated': special education teachers describe stress and attrition. Teacher Development, 24(3), 348-365.

Hwang, Y., Lee, J. H., & Shin, D. (2023). What is prompt literacy? An exploratory study of language learners' development of new literacy skill using generative AI. arXiv preprint arXiv:2311.05373.

Iwanicki, E. F., & Schwab, R. L. (1981).A cross validation study of the Maslach Burnout Inventory.Educational and psychological measurement, 41(4), 1167-1174.

Keengwe, J., & Onchwari, G. (Eds.). (2019). Handbook of research on literacy and digital technology integration in teacher education. IGI Global.

Kilonzo, T. M., Were, S., &Odhiambo, R. (2018). Job burnout and performance of teachers in secondary schools in Machakos County in Kenya. The Strategic Journal of Change and Business Management, 5(1), 551-583.

Kim, L. E., Jörg, V., & Klassen, R. M. (2019). A meta-analysis of the effects of teacher personality on teacher effectiveness and burnout. Educational psychology review, 31(1), 163-195.

Klaeijsen, A., Vermeulen, M., & Martens, R. (2018). Teachers' innovative behaviour: The importance of basic psychological need satisfaction, intrinsic motivation, and occupational self-efficacy. Scandinavian Journal of Educational Research, 62(5), 769-782.

Kleickmann, T., Tröbst, S., Jonen, A., Vehmeyer, J., &Möller, K. (2016).The effects of expert scaffolding in elementary science professional development on teachers' beliefs and motivations, instructional practices, and student achievement. Journal of Educational Psychology, 108(1), 21–42.

Korkealehto, K., & Siklander, P. (2018, June). Enhancing engagement, enjoyment and learning experiences through gamification on an English course for health care students. In Seminar. net (Vol. 14, No. 1, pp. 13-30).

Kulavuz-Onal, D., & Tatar, S. (2017). Teacher burnout and participation in professional learning activities: Perspectives from university English language instructors in Turkey. Journal of Language and Linguistic Studies, 13(1), 283-303.

Kwok, A. (2017). Relationships between instructional quality and classroom management for beginning urban teachers. Educational Researcher, 46(7), 355-365.

Kwon, K., Ottenbreit-Leftwich, A. T., Sari, A. R., Khlaif, Z., Zhu, M., Nadir, H., & Gok, F. (2019). Teachers' self-efficacy matters: Exploring the integration of mobile computing device in middle schools. TechTrends, 63, 682-692.

Lafferty, A., McConkey, R., & Taggart, L. (2013). Beyond friendship: The nature and meaning of close personal relationships as perceived by people with learning disabilities. Disability & Society, 28(8), 1074-1088.

Lan, Z., Sourina, O., Wang, L., Scherer, R., & Müller-Putz, G. R. (2018). Domain adaptation techniques for EEG-based emotion recognition: a comparative study on two public datasets. IEEE Transactions on Cognitive and Developmental Systems, 11(1), 85-94.

Lauermann, F., &König, J. (2016). Teachers' professional competence and wellbeing: Understanding the links between general pedagogical knowledge, self-efficacy and burnout. Learning and Instruction, 45, 9-19.

Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. Educational Media International, 55(1), 79-105.

Lazarides, R., Gaspard, H., &Dicke, A. L. (2019). Dynamics of classroom motivation: Teacher enthusiasm and the development of math interest and teacher support. Learning and Instruction, 60, 126-137.

Maquiling, Z. M. C. (2024). Enhancing Literacy and Numeracy Instruction in Multigrade Classrooms.

Maslach, C. (2018). Burnout: A multidimensional perspective. In Professional burnout: Recent developments in theory and research (pp. 19-32). CRC Press.

McCarthy, C. J., Lambert, R. G., Lineback, S., Fitchett, P., &Baddouh, P. G. (2016).Assessing teacher appraisals and stress in the classroom: Review of the classroom appraisal of resources and demands. Educational Psychology Review, 28(3), 577-603.

Mitchell, B. S., Hirn, R. G., & Lewis, T. J. (2017).Enhancing effective classroom management in schools: Structures for changing teacher behavior. Teacher Education and Special Education, 40(2), 140-153.

Mortazavizadeh, S. H., & Azizi Mahmoodabad, M. (2023). The effect of integrated education on learning math lessons in students in multigrade classes. The Journal of New Thoughts on Education, 19(3), 117-135.

Naparan, G. B., & Alinsug, V. G. (2021). Classroom strategies of multigrade teachers. Social Sciences & Humanities Open, 3(1), 100109.

Näring, G., Vlerick, P., & Van de Ven, B. (2012). Emotion work and emotional exhaustion in teachers: The job and individual perspective. Educational Studies, 38(1), 63-72.

O'Toole, V. M. (2018). "Running on fumes": emotional exhaustion and burnout of teachers following a natural disaster. Social Psychology of Education, 21(5), 1081-1112.

Ongus, R. W., Aming'a, N. N., Nyamboga, C. M., &Okello, G. (2016).Knowledge Management Practices and Organizational Performance in Selected Campuses of Kisii University, Kenya.

Peiris-John, R., Selak, V., Robb, G., Kool, B., Wells, S., Sadler, L., & Wise, M. R. (2020). The state of quality improvement teaching in medical schools: a systematic review. Journal of Surgical Education, 77(4), 889-904.

Phytanza, D. T. P., & Burhaein, E. (2020). The effects of tenure, teacher certification, and work motivation on special needs teacher performance. Universal Journal of Educational Research, 8(9), 4348-4356.

Praetorius, A. K., Grünkorn, J., &Klieme, E. (2020).Towards developing a theory of generic teaching quality: origin, current status, and necessary next steps regarding the three basic dimensions model.ZeitschriftfürPädagogik.Beiheft, 66(1), 15-36.

Prasojo, L. D., Habibi, A., Yaakob, M. F. M., Mukminin, A., Haswindy, S., & Sofwan, M. (2019). An Explanatory Sequential Study on Indonesian Principals' Perceptions on ICT Integration Barriers. Electronic Journal of e-Learning, 17(1), 1-10.

Rakhmawati, Y., & Mustadi, A. (2022). The circumstances of literacy numeracy skill: Between notion and fact from elementary school students. Jurnal Prima Edukasia, 10(1), 9-18.

Rahimi, S., Wang, H., & Hall, N. C. (2017). Social comparisons: Effects of teaching experience on adjustment and emotions in new teachers.

Rendon, R., & Agdana, F. M. (2022). Difficulties of Multigrade Pupils in Learning English Language: Basis for an Enhancement Program. Psychology and Education: A Multidisciplinary Journal, 3(4), 312-320.

Rumschlag, K. E. (2017). Teacher burnout: A quantitative analysis of emotional exhaustion, personal accomplishment, and depersonalization. International management review, 13(1), 22-36.

Salminen, J., Khanolainen, D., Koponen, T., Torppa, M., & Lerkkanen, M. K. (2021, October). Development of numeracy and literacy skills in early childhood—A longitudinal study on the roles of home environment and familial risk for reading and math difficulties. In Frontiers in Education (Vol. 6, p. 725337). Frontiers Media SA.

Schussler, D. L., Greenberg, M., DeWeese, A., Rasheed, D., DeMauro, A., Jennings, P. A., & Brown, J. (2018). Stress and release: Case studies of teacher resilience following a mindfulness-based intervention. American Journal of Education, 125(1), 1-28.

Sheninger, E. (2019). Digital leadership: Changing paradigms for changing times. Corwin Press.

Shoji, K., Cieslak, R., Smoktunowicz, E., Rogala, A., Benight, C. C., &Luszczynska, A. (2016). Associations between job burnout and self-efficacy: A meta-analysis. Anxiety, Stress, & Coping, 29(4), 367-386.

Skaalvik, E. M., &Skaalvik, S. (2016). Teacher stress and teacher self-efficacy as predictors of engagement, emotional exhaustion, and motivation to leave the teaching profession.Creative Education, 7(13), 1785.

Snyder, T. D., De Brey, C., & Dillow, S. A. (2016). Digest of Education Statistics 2014, NCES 2016-006. National Center for Education Statistics.

Strong, S. (2011). The Thoughtful Classroom teacher effectiveness framework: Teacher self-assessment guide.

Suprayogi, M. N., Valcke, M., & Godwin, R. (2017). Teachers and their implementation of differentiated instruction in the classroom.

Teaching and Teacher Education, 67, 291-301.

Tailor, K. (2022). Evaluating the impact of technology-supported personalised learning interventions on the mathematics achievements of elementary students in India.

Taole, M. J. (2024). ICT Integration in a Multigrade Context: Exploring Primary School Teachers Experiences. Research in Social Sciences and Technology, 9(1), 232-252.

Tiernan, B., Casserly, A. M., & Maguire, G. (2020). Towards inclusive education: instructional practices to meet the needs of pupils with special educational needs in multi-grade settings. International Journal of Inclusive Education, 24(7), 787-807.

Tondeur, J., Scherer, R., Baran, E., Siddiq, F., Valtonen, T., & Sointu, E. (2019). Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. British Journal of Educational Technology, 50(3), 1189-1209.

Tout, D. (2020). Evolution of adult numeracy from quantitative literacy to numeracy: Lessons learned from international assessments. International Review of Education, 66(2), 183-209.

Uitto, A., Boeve-de Pauw, J., &Saloranta, S. (2014). Educational factors explaining 9th graders self-efficacy in ecological sustainable behaviours. In E-Book Proceedings of the ESERA 2013 Conference: Science Education Research For Evidence-based Teaching and Coherence in Learning. Part 9 (co-ed. GracaGarvalho and Marianne Mortensen Foss).European Science Education Research Association ESERA.

Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. Computers & Education, 118, 70-81.

Wei, H. (2019, November). Research on Teaching Quality Improvement Strategy in Higher Vocational Colleges.In 2nd International Conference on Humanities Education and Social Sciences (ICHESS 2019) (pp. 478-481).Atlantis Press.

Wong, K. L., Lee, C. K. J., Chan, K. S. J., & Kennedy, K. J. (2019). Teacher self-efficacy in cultivating students to become 'good citizens': a Hong Kong case. Teacher Development, 23(2), 155-173.

Xiao, F., Barnard-Brak, L., Lan, W., & Burley, H. (2019). Examining problem-solving skills in technology-rich environments as related to numeracy and literacy. International Journal of Lifelong Education, 38(3), 327-338.

Yılmaz, A. (2021). The effect of technology integration in education on prospective teachers' critical and creative thinking, multidimensional 21st century skills and academic achievements. Participatory Educational Research, 8(2), 163-199.

Zee, M., &Koomen, H. M. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: A synthesis of 40 years of research. Review of Educational research, 86(4), 981-1015.

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